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Reduction of vertebrate coprolite diversity associated with the end-Permian extinction event in Vyazniki region, European Russia

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ABSTRACT

This study investigates the paleoecological significance of vertebrate coprolites collected from seven sections and three lithofacies of the uppermost Permian and lowermost Triassic succession from the Vyazniki site in the European part of Russia. The analyzed specimens (coprolites and possibly some cololites) were grouped into nine morphotypes (A–I). The coprolite morphotypes were characterized geochemically and compared to the record of other Permian and Triassic coprolites worldwide. Based on the stratigraphic position, shape, structure and composition, all morphotypes were linked to supposed producers. The phosphatic composition of most of the morphotypes and inclusions of arthropod remains, fish scales and bone fragments, suggest that they were produced by carnivores, but non-phosphatic, carbonate-rich, large and oval-shaped coprolites with impressions after plant remains have also been found. The extinction of terrestrial vertebrates around the Permian–Triassic boundary in Russia is interpreted to have occurred within a few thousands of years. Here, we show a pattern of coprolite morphotypes disappearing across this boundary that is consistent with a relatively sudden change in the vertebrate faunal composition across this interval.

1. Introduction

Coprolites (fossil feces) are important sources of paleoecological information and can reveal aspects of diets and ecology of extinct fauna (Chin and Kirkland, 1998; Chin et al., 2009; Wood et al., 2012; Dentzien-Dias et al., 2013; Bajdek et al., 2014). Difficult, but especially interesting is to ascribe the coprolite morphotypes to their producers (Chin et al., 1998; Chin, 2007; Owocki et al., 2012; Bajdek et al., 2014). This is important as coprolites may provide information on predator–prey relationships and allow reconstructions of trophic structures in ancient ecosystems (Chin et al., 2008; Zatoń et al., 2015).

Coprolite material can be a useful source of data on changes in ecosystems during mass extinctions. In recent years, Suazo et al. (2012) described Upper Cretaceous through lower Cenozoic vertebrate coprolites from the San Juan Basin, New Mexico, but concluded that morphologies and contents of those coprolites do not change significantly across the Cretaceous/Paleogene boundary. Nakajima and Izumi (2014) described Lower Triassic (Olenekian) coprolites of most likely nektonic animals from the marine deposits of the Osawa Formation, Japan, providing some information on the diversity and trophic structure of marine ecosystems following the end-Permian mass extinction. Brachaniec et al. (2015) described a rich coprolite collection from the latest Olenekian of Poland that implies that durophagous predation was intense during the Early Triassic. In addition, Brachaniec et al. (2015) suggested that the so-called predation-driven Mesozoic Marine Revolution had already started soon after the end-Permian extinction.

Since the published data on the distribution and diversity of the Upper Permian-Lower Triassic coprolites are scarce, the new data presented here may be of a particular interest. Our study of coprolite assemblages collected from the Permian–Triassic deposits of Vyazniki, presents new data about the changing trophic structures of the terrestrial vertebrate communities from the latest Permian to earliest Triassic in northern Pangea. We document the stratigraphic ranges of the various vertebrate coprolite morphotypes spanning the Permian–Triassic interval at Vyazniki (Fig. 1A), European part of Russia (Russian Platform), within seven sections exposed in five localities (Fig. 1B). This detailed record of coprolite diversity was then used as an indicator of changes in diversity of vertebrate populations in the ancient ecosystems. Coprolites in the uppermost Permian of Vyazniki was firstly

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